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Maine Department of Transportation

Transportation Research Division

Technical Memorandum 03-11

Field Testing of Alternative Carbide Edge Snow Plow Blades

March 2004

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The new type of snow plow blade with a uniquely designed carbide inserts failed to perform as well as conventional carbide blades with conventional trapezoidal inserts.

Introduction

The Maine Department of Transportation uses almost 2,500 carbide cutting edges on its fleet of highway snow plow trucks each winter. This represents almost 9,000 linear ft. of cutting edges and an annual expenditure of roughly $150,000 each winter season. This does not include the number of regular steel or hardened steel blades used on other types of equipment such as graders, bucket loaders, etc. The number of replacement blades used in any particular season, and the annual costs for these blades, depend on the number and severity of winter storms and the condition of the roads. The expected life of a set of carbide edge blades is highly variable. Estimates range from 100 to 500 hours of plowing time per set. Longer lasting could lead to significant cost savings.

Problem Statement

Conventional carbide cutting edges are manufactured by placing small trapezoidal carbide inserts into a groove that is cut into the underside edge along the bottom edge of the steel plow blade. Carbide is a complex metal alloy of tungsten that is tougher and resists abrasion better than simple steel. The carbide, however, can be more brittle than steel. The severe shock loads experienced by plows hitting rough broken pavement, rocks, curbs, or other objects can crack and break the carbide edges, leading to rapid wear on the edge. Maintenance crews say that once the carbide is gone the blade must be replaced immediately, because the remaining steel will not last even one storm. After that damage to the plow itself will result and lead to costly repairs. Cracks develop in the carbide which spread to adjacent sections leading to increased breakage.

Figure 1a. Hairline Cracks Spreading to Adjacent Carbide Inserts

Figure 1b.Edge View Where Carbide has Broken

Blade manufacturers continue to develop new types of blades in an attempt to address excessive blade wear. In general these new blades cost more than conventional carbide edge blades. One new type of blade uses small round plugs of carbide that are inserted into round holes drilled into the steel blade. It is claimed that this configuration of carbide, isolates the individual inserts so that shock loads are not transmitted to adjacent tungsten units, thereby reducing breakage. These replacement blades cost about 50% more than conventional blades but are said to last up to three times longer. The goal of this research project was to test the new blades side-by-side with conventional blades, and evaluate the cost effectiveness of these blades.

The benefit of this research will be to determine the cost-effectiveness of the new blades. Another benefit will be to establish a baseline of data on current blade performance, against which future blade evaluations can be made. Longer lasting blades would also reduce maintenance costs associated with changing out blades, including the risk of injuries resulting from the awkward task of changing heavy plow blades. If the new blades have a lower cost, immediate cost savings could be realized each winter with the new blades, since the new blades are commercially available through the normal competitive bidding process.

Field Testing Procedure

The field testing consisted of outfitting several trucks with new sets of the isolated carbide tipped blades. In addition, some trucks will have convention carbide blades from the same vendor. An equal number of similar trucks will be outfitted with conventional carbide blades currently in use and supplied Motor Transport under a supply contract. Trucks and crews for the test were chosen with the goal of having similar plow routes, lengths, road conditions and call-out priority. The test trucks and control trucks were from Divisions1,2,5, &7. The crews recorded the number of hours of plowing time for each set of blades until the blade sets needed changing. Test locations were established as follows: Div.1- Amity, Rt. 1, Div. 2- Ellsworth Rt. 1A, Gouldsboro, Rt.1, Baileyville, Rt. 1, Div. 5- Richmond, I-95 & Rt. 197, Div. 7- South Paris, Rt. 118

Figure 2. Truck Outfitted with Test Blades on Both Front and Wing Plows

Figure 3. Test Blades as seen from the Road Perspective

Figure 4. View of Remaining Carbide Inserts after Plowing Several Storms

Results

The new blades do not appear to last as long as stock blades. Despite the increased cost, the test blades lasted 80% as long as stock blades. It is not clear why this occurred. Differences in pavement condition may have contributed somewhat despite efforts to control for this factor. In was noted however that breakage of the blades did not appear to be an important factor; the blades simply wore down until they were unusable. It may be that the new type of blade is designed more for breakage resistance than abrasion. The table below shows the results of the tests.

Snow Plow Blade Tests

	Isolated Carbide Insert Blades (Test)						Regular Carbide Insert Blades (Control)					
		Miles	Hours	Ave. MPH	Ave. Cost (per lane-mile)	Ave. Cost (per hour)		Miles	Hours	Ave. MPH	Ave. Cost (per lane-mile)	Ave. Cost (per hour)
Amity		775.0	32.5	23.8	$0.38	$9.14		1014.0	53.8	18.9	$0.19	$3.63
Ellsworth		1161.0	63.5	18.3	$0.26	$4.68		1070.0	82.5	13.0	$0.18	$2.37
Baileyville		1036.0	95.0	10.9	$0.29	$3.13		1255.0	113.0	11.1	$0.16	$1.73
Richmond		1140.0	57.0	20.0	$0.26	$5.21						
South Paris		1280.0	63.7	20.1	$0.23	$4.66		1280.0	63.7	20.1	$0.15	$3.07
	Ave.	990.7	62.3	18.6	$0.28	$5.36	Ave.	1154.8	78.2	15.8	$0.17	$2.70
	Regular Carbide Insert Blades (Test, Alternative Brand)						**Regular Carbide Insert Blade (Control, Stock Brand)**					
		Miles	Hours	Ave. MPH	Ave. Cost (per lane-mile)	Ave. Cost (per hour)		Miles	Hours	Ave. MPH	Ave. Cost (per lane-mile)	Ave. Cost (per hour)
Gouldsboro		811.4	45.9	17.7	$0.37	$6.47		1786.0	62.8	28.5	$0.11	$3.11
Richmond		1360.0	68.0	20.0	$0.22	$4.37						
	Ave.	1085.7	57.0	18.8	$0.29	$5.42		1786.0	62.8	28.5	$0.11	$3.11

Assumptions:		
Costs (per foot)	Isolated Carbide Blades	$27.00
	Regular Carbide Blades (Alternative)	$17.76
	Regular Carbide Blades (Stock)	$17.76

The new type of experimental blades cost about $27 per lineal foot of blade. The conventional blades cost nearly $18 per blade. On average the test blades lasted about 62 hours and 990 miles. Stock blades lasted over 78 hours and over 1150 miles. The average cost for the test blades was 28 cents/mile and $5.36 per plowing hour. The average cost for stock blades was 17 cents/mile and $2.70 per plowing hour.

Photos

Figure 5. Test Blades after Removal, Showing Remaining Round Carbide Inserts

Figure 6. Close-up of Carbide Inserts. Photo shows the right side of the left-most blade (as viewed from "driver's" side of plow.)

Figure 7. Test Blade With Carbide Completely Worn Off

Figure 8. Control Blades

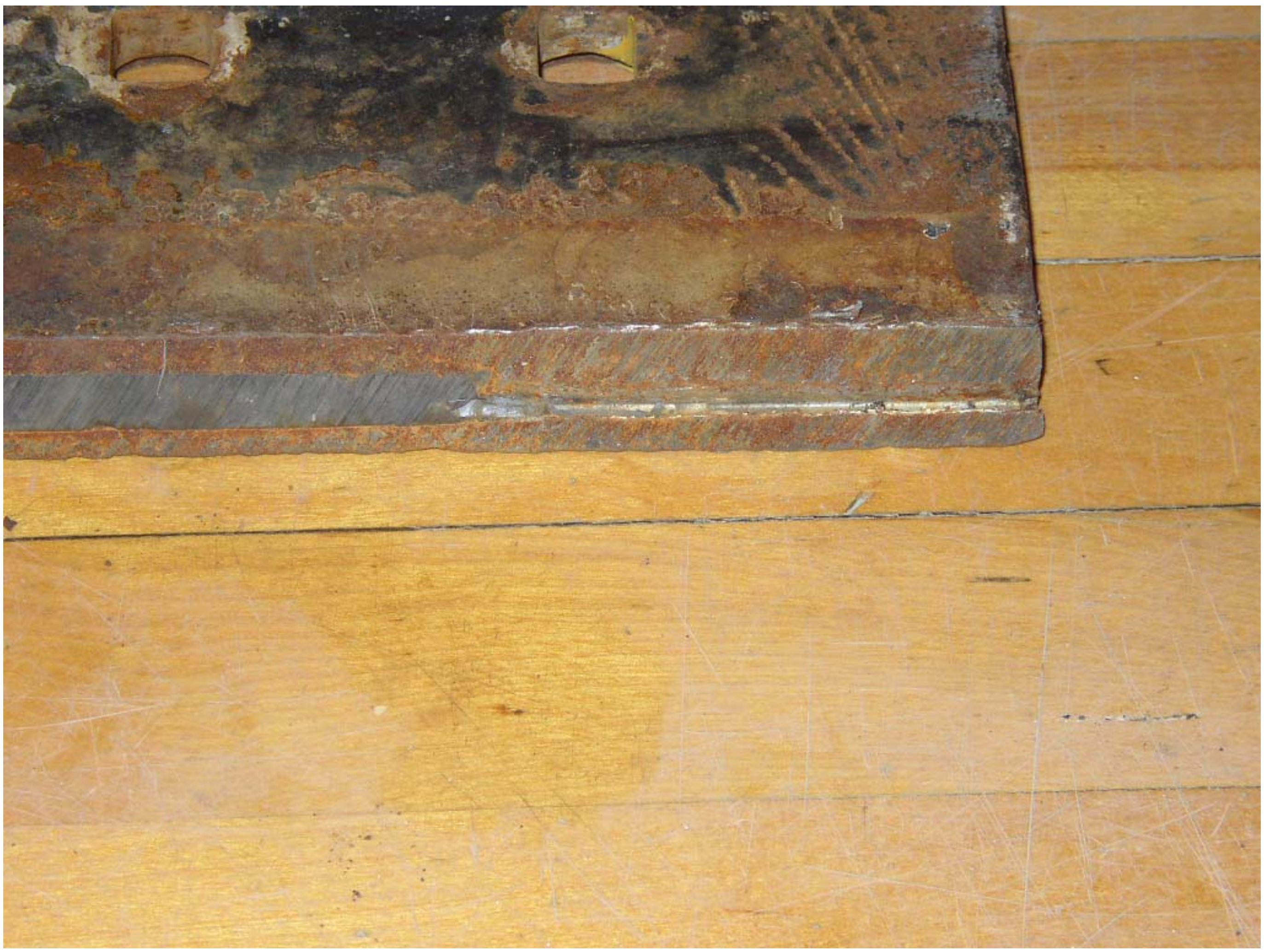

Figure 9. Control Blade with Carbide Gone Near the leading Edge

Figure 10. Control Blades With Some Carbide Remaining

Conclusions

Preliminary results seem to indicate that the new blades do not last as long as regular stock blades. The new blades may perform well on concrete pavement. At this time, however, it is not clear if the new type blades will outlast the regular blades on the concrete pavement. Even if this proves to be true, Maine has few concrete roads. Another season of data collection is needed before the final results will be available. This research has shown that, so far, the new blades are not a cost-effective application for most Maine asphalt roads. The research has also established baseline performance data for conventional carbide blades; that data will be useful for future comparisons and evaluations.

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